

1000 U.S. PTO
Barcode

07/28/00

07-31-00 EL702837498US

A Re

PATENT

Practitioner's Docket No. DCC-10003/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Date: 07/26/00

Assistant Commissioner for Patents
Washington, D.C. 20231

1000 U.S. PTO
Barcode
09/628944
07/28/00

REISSUE APPLICATION TRANSMITTAL

Transmitted herewith is the application for reissue of U.S.

Utility Patent Plant Patent Design Patent

No. 5,785,021 issued on 7/28/98

Inventor(s): Sergi Yudanov, William Richard Mitchell

Title: HYRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM
Enclosed are the following:

1. Specification, claim(s) and drawing(s) (37 C.F.R. § 1.173)

(a) 9 page(s) of specification

4 page(s) of claims

1 page(s) of abstract

NOTE: *This must include the entire specification and claims of the patent, with the matter to be omitted by reissue enclosed in square brackets. Any additions made by the reissue must be underlined, so that the old and new specifications and claims may be readily compared. Claims should not be renumbered. The numbering of claims added by reissue should follow the number of the highest numbered patent claim. No new matter shall be introduced into the specification. (37 C.F.R. § 1.173).*

CERTIFICATION UNDER 37 C.F.R. § 1.10*

(Express Mail label number is mandatory.)

(Express Mail certification is optional.)

I hereby certify that this Reissue Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date July 29, 2000, in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL702837498US, addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Veronica Andris

(type or print name of person mailing paper)

Veronica Andris
Signature of person mailing paper

WARNING: Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. § 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

***WARNING:** Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. § 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.

(b) 8 sheet(s) of drawing (drawings amended)

Formal
 Informal

NOTE: "Amendments which can be made in a reissue drawing, that is, changes from the drawing of the patent, are restricted." 37 C.F.R. § 1.174(b).

No changes in the drawings, upon which the original patent was issued, are to be made. Therefore, in accordance with 37 C.F.R. § 1.174(a), please find attached, in the size required for original drawings:
 a copy of the printed drawings of the patent.
 a photoprint of the original drawings.
 A letter requesting transfer of the drawings from the original patent file to this reissue application is attached.

2. Declaration and power of attorney

8 pages of declaration and power of attorney

3. Preliminary amendment

(check, if applicable)

Attached

4. Offer to surrender the original letters patent in accordance with 37 C.F.R. § 1.178
is attached.

Offer to surrender is by the inventor
 along with assent of assignee.
 Offer to surrender is by the assignee of the entire interest (and the reissue application does not seek to enlarge the claims of the original patent).

5. Letters patent

Original letters patent are attached.
 Declaration that original letters patent lost or inaccessible is attached.
 A copy of the original printed patent is attached.

NOTE: "The application may be accepted for examination in the absence of the original patent or the declaration but one or the other must be supplied before the case is allowed." 37 C.F.R. § 1.178.

NOTE: "Where the original patent grant is not submitted with the reissue application as filed, patentee should include a copy of the printed original patent. Presence of a copy of the original patent is useful for the calculation of the reissue filing fee and for the verification of other identifying data." M.P.E.P., § 1416, 7th ed.

NOTE: "If a reissue be refused, the original patent will be returned to applicant upon his request." 37 C.F.R. § 1.178.

6. Petition to proceed without assignee's assent

Attached hereto is a "PETITION TO PROCEED WITH REISSUE APPLICATION WITHOUT ASSIGNEE'S ASSENT".

A. The fee payment is authorized in the attached:

"REISSUE APPLICATION TRANSMITTAL" Form

"COMPLETION OF FILING REQUIREMENTS — REISSUE APPLICATION" Form.

B. Payment is authorized below.

7. Information Disclosure Statement

Attached

Copies of the IDS citation(s) is/are attached.

8. Priority—35 U.S.C. § 119

Priority of application Application No. 0 /PCT/AU95/00073 filed on 2/15/95, in _____ is claimed under 35 U.S.C. § 119.
Country and AU SN PM3876 filed 2/15/94 and AU PN 0176
 filed 12/21/94

The certified copy has been filed in prior application Application No. 0 PCT/AU95/00073 filed on 2/15/95.

9. Basic Filing Fee Calculation (37 C.F.R. § 1.16(h), (i) and (j))

CLAIMS AS FILED				
Number Filed	Number Extra	Rate	Basic Fee (37 C.F.R. 1.16(h))	
Total Claims (37 C.F.R. § 1.16(j))	19	— 20 (and also in excess of total claims in patent)	X	\$690.00
Independent Claims 37 C.F.R. § 1.16(i))	4	— (number of independent claims in patent)	X	\$78.00
				78
	Filing fee Calculation		\$	768

NOTE: Multiple dependent claims are treated as ordinary claims for fee purposes. 37 C.F.R. § 1.16(j).

(Reissue Application Transmittal [17-1]—page 3 of 6)

10. Small Entity Status (if applicable)

NOTE: A new statement is required for the reissue, even if one has been filed in the original patent. 37 C.F.R. § 1.27(a).

WARNING: "Small entity status must not be established when the person or persons signing the . . . statement can **unequivocally** make the required self-certification." M.P.E.P. § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

A statement that this filing is by a small entity is
 attached.

Filing Fee Calculation (50% of above) \$ 384

NOTE: If a statement is filed within 2 months of the date of timely payment of a fee, then the excess fee paid will be refunded on request. 37 C.F.R. § 1.28(a). Effective April 1, 1984.

11. Additional Fee Payments

Payment is being made for "PETITION TO PROCEED WITH REISSUE APPLICATION WITHOUT ASSIGNEE"
(37 C.F.R. § 1.17(h)) \$130.00

12. Total Fees Due

Filing Fee	\$ <u>384</u>
Petition fee	\$ _____
Total Fees Due	\$ <u>384</u>

13. Method Of Payment of Fees

Enclosed is a check in the amount of \$ 384.
 Charge Account No. _____ in the amount of \$ _____.
A duplicate of this request is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 C.F.R. § 1.22(b).

(Reissue Application Transmittal [17-1]—page 4 of 6)

14. Authorization To Charge Additional Fees

WARNING: *If no fees are to be paid on filing, the following items should not be completed.*

WARNING: *Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.*

The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 07-1180 :

37 C.F.R. § 1.16(a), (f) or (g) (filing fees)

37 C.F.R. § 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: *Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 C.F.R. § 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.*

37 C.F.R. § 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

37 C.F.R. § 1.17(a)(1)–(5) (extension fees pursuant to § 1.136(a)).

37 C.F.R. § 1.17 (application processing fees)

NOTE: *"A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).*

NOTE: *"Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).*

37 C.F.R. § 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. § 1.311(b))

NOTE: *Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 C.F.R. § 1.311(b).*

NOTE: See 37 C.F.R. § 1.28.

15. Additional Enclosures

Reg. No. 27,394

Reg. No.: 27,394

Tel. No.: (248) 647-6000

Customer No.:



25006

PATENT TRADEMARK OFFICE

SIGNATURE OF PRACTITIONER

Douglas W. Sprinkle
(type or print name of practitioner)

280 N. Old Woodward Ave., Ste. 400
P.O. Address

Birmingham, MI 48009

(Reissue Application Transmittal [17-1]—page 6 of 6)

Practitioner's Docket No. DCC-10003/04

PATENT

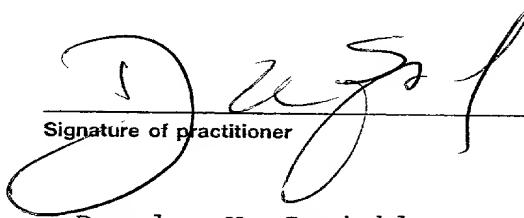
**REQUEST FOR TRANSFER OF DRAWINGS FROM ORIGINAL PATENT
TO REISSUE APPLICATION**

Please transfer the drawings from original patent, 5,785,021, filed on
7/28/98, for the invention entitled HYRAULICALLY ACTUATED
ELECTRONIC FUEL INJECTION SYSTEM

to the reissue application, the specification of which:

is attached hereto.
 was filed on _____, as reissue application number /

Date: 7/27



Signature of practitioner

Douglas W. Sprinkle
(type or print name of practitioner)

Reg. No.: 27,394

280 N. Old Woodward Ave., Suite 400
Birmingham, MI 48009

P.O. Address

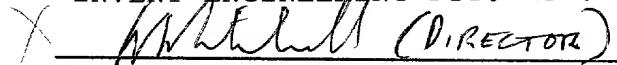
Tel. No. 248-647-6000

Customer No.: 25006

STATEMENT BY ASSIGNEE

Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

INVENT ENGINEERING PTY. LTD.

 *W. Whelchell (Director)*

Signature of assignee or person authorized to sign on behalf of assignee

(check proper box(es) for any added page(s) forming a part of this declaration)

Signature for third and subsequent joint inventors. Number of pages added. _____

Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added. _____

Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. § 1.47. Number of pages added. _____

Statement of inoperativeness or invalidity of original patent. 37 C.F.R. § 1.175. Number of pages added 1.

Authorization of attorney(s) to accept and follow instructions from representative.

Corroborating statements of others.

(Reissue Application Declaration and Power of Attorney [17-6]—page 6 of 6)



STATEMENT BY ASSIGNEE

Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

SERGI YUDANOV

Signature of assignee or person authorized to sign on behalf of assignee

(check proper box(es) for any added page(s) forming a part of this declaration)

Signature for third and subsequent joint inventors. Number of pages added. _____

Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added. _____

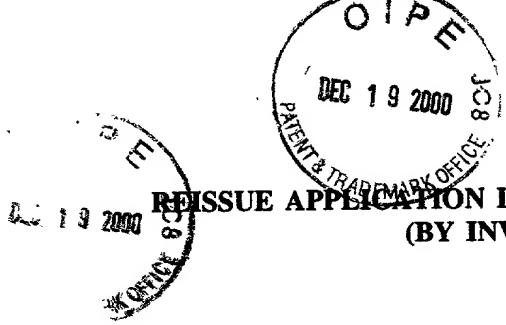
Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. § 1.47. Number of pages added. _____

Statement of inoperativeness or invalidity of original patent. 37 C.F.R. § 1.175. Number of pages added _____

Authorization of attorney(s) to accept and follow instructions from representative.

Corroborating statements of others.

(Reissue Application Declaration and Power of Attorney [17-6]—page 6 of 6)



**REISSUE APPLICATION DECLARATION AND POWER OF ATTORNEY
(BY INVENTOR(S) OR ASSIGNEE)**

ADDED PAGE

As the below named inventor, I hereby declare: my residence, post office address and citizenship are as stated below next to my name; and I believe I am the original, first and sole inventor of the invention which is described and claimed in U.S. Patent 5,785,021 entitled HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM that issued July 28, 1998, and in the reissue application thereof the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I believe that my original patent is partly inoperative or invalid for the reason that I claimed less than I had a right to claim in the patent.

Specifically, the patent was based upon Application No. PCT/AU95/00073. That PCT Application, as originally filed with the U.S. Patent and Trademark Office included 14 claims. However, Claim 14, a method claim, appears to have never been considered by the patent office. Furthermore, on November 12, 1996 a Supplemental Preliminary Amendment was filed that added new Claims 19-21. Those claims were subsequently allowed and renumber Claims 16-18 but were not printed as part of the patent. The amended Claim 14 and unpublished Claims 16-18 have been added to the present application as Claims 16-19.

Claim 3 has been amended to delete the multiple dependencies that should have been originally removed as a result of the Supplemental Preliminary Amendment filed November 12, 1996. Initially, Claims 5 and 11 have been amended to more clearly disclose and claim the invention.

I further declare that the aforementioned error occurred without any deceptive intention on my part and that all statements made herein of my own knowledge are true and that the statements are made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment or both under Section 1001 under Title 18 of the United States Code and such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Therefore, I pray that I be allowed and I hereby offer to surrender the original United States Letters Patent No. 5,785,021 for HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM and that the Letters Patent may be reissued to claim and protect all that I was entitled to claim.

(Reissue Application Declaration and Power of Attorney [17-6] _____ Added page _____)

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(b)Applicant/Patent Owner: Sergi Yudanov and William Richard MitchellApplication No./Patent No.: 5,785,021 Filed/Issue Date: 7/28/98Entitled: Hydraulically Actuated Electronic Fuel Injection SystemInvent Engineering Pty Ltd., a corporation

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that it is:

- the assignee of the entire right, title, and interest; or
- an assignee of an undivided part interest

in the patent application/patent identified above by virtue of either:

A. An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the Patent and Trademark Office at Reel 8634 Frame 0033 or for which a copy thereof is attached.

OR

B. A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.
2. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.
3. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

 Additional documents in the chain of title are listed on a supplemental sheet. Copies of assignments or other documents in the chain of title are attached.

[NOTE: A separate copy (i.e., the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the PTO. See MPEP 302-302.8]

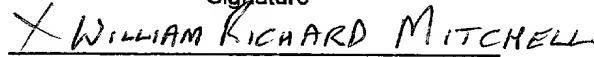
The undersigned (whose title is supplied below) is empowered to sign this statement on behalf of the assignee.

23 NOVEMBER 2000

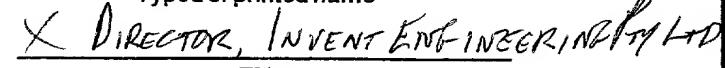
Date



Signature



Typed or printed name



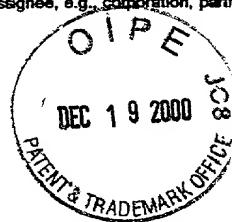
Title

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(b)Applicant/Patent Owner: Sergi Yudanov and William Richard MitchellApplication No./Patent No.: 5,785,021 Filed/Issue Date: 7/28/98Entitled: Hydraulically Actuated Electronic Fuel Injection SystemSergi Yudanov, an individual
(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)



states that it is:

- the assignee of the entire right, title, and interest; or
- an assignee of an undivided part interest

in the patent application/patent identified above by virtue of either:

A. An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the Patent and Trademark Office at Reel 8634 Frame 0033 or for which a copy thereof is attached.

OR

B. A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as shown below:

1. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____ Frame _____, or for which a copy thereof is attached.
2. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____ Frame _____, or for which a copy thereof is attached.
3. From: _____ To: _____
The document was recorded in the Patent and Trademark Office at
Reel _____ Frame _____, or for which a copy thereof is attached.

 Additional documents in the chain of title are listed on a supplemental sheet. Copies of assignments or other documents in the chain of title are attached.

[NOTE: A separate copy (i.e., the original assignment document or a true copy of the original document) must be submitted to Assignment Division in accordance with 37 CFR Part 3, if the assignment is to be recorded in the records of the PTO. See MPEP 302-302.8]

The undersigned (whose title is supplied below) is empowered to sign this statement on behalf of the assignee.

4 DECEMBER 2000
Date

X KRM
Signature

Sergi Yudanov
Typed or printed name

Title

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

Practitioner's Docket No. DCC-10003/04**PATENT****ASSENT BY ASSIGNEE FOR FILING OF REISSUE APPLICATION**

NOTE: The written assent of all assignees, if any, owning an undivided interest in the original patent must be included in the application for reissue. 37 C.F.R. 1.172(a).

This is part of the application for a reissue patent filed herewith based on the original patent identified as follows:

Sergi Yudanov and William Richard Mitchell
Name of Patentee

5,785,021
Patent Number

7/28/98
Date Patent Issued

Hydraulically Actuated Electronic Fuel Injection System
Title of Invention

I am an assignee owning

an undivided interest to the above original patent.
 a 50 % (per cent) interest in the above original patent.
I assent to the accompanying application for reissue.

Invent Engineering Pty Ltd
Name of assignee

W. Mitchell
Signature of person signing for assignee

23 NOVEMBER 2000
Date:

WILLIAM RICHARD MITCHELL, (DIRECTOR)
(type or print name and title of person signing for assignee)

Practitioner's Docket No. DCC-10003/04

PATENT

ASSENT BY ASSIGNEE FOR FILING OF REISSUE APPLICATION

NOTE: The written assent of all assignees, if any, owning an undivided interest in the original patent must be included in the application for reissue. 37 C.F.R. 1.172(a).

This is part of the application for a reissue patent filed herewith based on the original patent identified as follows:

Sergi Yudanov and William Richard Mitchell

Name of Patentee

5,785,021

Patent Number

7/28/98

Date Patent Issued

Hydraulically Actuated Electronic Fuel Injection System

Title of Invention

I am an assignee owning

an undivided interest to the above original patent.
 a 50 % (per cent) interest in the above original patent.
I assent to the accompanying application for reissue.

Sergi Yudanov

Name of assignee

X



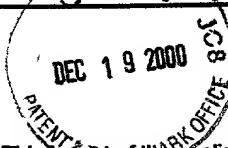
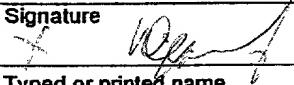
Signature of person signing for assignee

X Date: 4 DECEMBER 2000

Sergi Yudanov

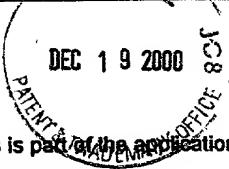
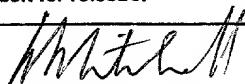
(type or print name and title of person signing for assignee)

3

REISSUE APPLICATION BY THE INVENTOR, OFFER TO SURRENDER PATENT		Docket Number (Optional) DCC-10003/04		
 <p>This is part of the application for a reissue patent based on the original patent identified below.</p>				
<p>Name of Patentee(s) Sergi Yudanov, William Richard Mitchell</p> <table border="1"> <tr> <td>Patent Number 5,785,021</td> <td>Date Patent Issued 7/28/98</td> </tr> </table> <p>Title of Invention HYRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM</p>			Patent Number 5,785,021	Date Patent Issued 7/28/98
Patent Number 5,785,021	Date Patent Issued 7/28/98			
<p>I am the inventor of the original patent.</p> <p>I offer to surrender the original patent.</p> <p>1. <input checked="" type="checkbox"/> Filed herein is a certificate under 37 CFR 3.73(b).</p> <p>2. <input type="checkbox"/> Ownership of the patent is in the inventor(s), and no assignment of the patent has been made.</p> <p>One of boxes 1 or 2 above must be checked.</p> <p>The written consent of all assignees owning an undivided interest in the original patent is included in this application for reissue.</p>				
<p>Signature </p> <p>Typed or printed name Sergi Yudanov</p>		<p>Date 4 DECEMBER 2000</p>		
<p>The assignee owning an undivided interest in said original patent is _____, and the assignee consents to the accompanying application for reissue.</p> <p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application, any patent issued thereon, or any patent to which this declaration is directed.</p> <p>Name of assignee</p>				
<p>Signature of person signing for assignee</p>		<p>Date</p>		
<p>Typed or printed name and title of person signing for assignee</p>				

Burden Hour Statement: This form is estimated to take 0.1 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

(Reissue Application by the Inventor — Offer to Surrender Patent (PTO/SB/53) [17-2.1]—page 1 of 1)

REISSUE APPLICATION BY THE INVENTOR, OFFER TO SURRENDER PATENT		Docket Number (Optional)
DCC-10003/04		
 <small>This is part of the application for a reissue patent based on the original patent identified below.</small>		
Name of Patentee(s) Sergi Yudanov, William Richard Mitchell		
Patent Number	Date Patent Issued	
5,785,021	7/28/98	
Title of Invention HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM		
I am the inventor of the original patent. I offer to surrender the original patent.		
1. <input checked="" type="checkbox"/> Filed herein is a certificate under 37 CFR 3.73(b). 2. <input type="checkbox"/> Ownership of the patent is in the inventor(s), and no assignment of the patent has been made.		
One of boxes 1 or 2 above must be checked.		
The written consent of all assignees owning an undivided interest in the original patent is included in this application for reissue.		
Signature	Date	
 X 23 NOVEMBER 2000		
Typed or printed name William Richard Mitchell		
The assignee owning an undivided interest in said original patent is _____, and the assignee consents to the accompanying application for reissue.		
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application, any patent issued thereon, or any patent to which this declaration is directed.		
Name of assignee		
Signature of person signing for assignee	Date	
 X		
Typed or printed name and title of person signing for assignee		

Burden Hour Statement: This form is estimated to take 0.1 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

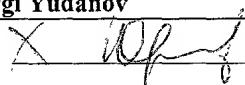
(Reissue Application by the Inventor — Offer to Surrender Patent (PTO/SB/53) [17-2.1]—page 1 of 1)

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (b)) - INDEPENDENT INVENTOR				Docket No. DCC-10003/04
Serial No. 08/693,138	Filing Date 11/12/96	Patent No. 5,785,021	Issue Date 07/28/98	
<p>Applicant/ Sergi Yudanov, William Richard Mitchell Patentee:</p> <p style="text-align: center; font-size: small; margin: 0;">O I P T</p> <p style="text-align: center; font-size: small; margin: 0;">DEC 19 2000</p> <p style="text-align: center; font-size: small; margin: 0;">P A T E N T & T R A D E M A R K O F F I C E</p>				
<p>Invention: HYRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM</p>				
<p>As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, to the Patent and Trademark Office with regard to the invention entitled above and described in:</p> <p><input type="checkbox"/> the specification to be filed herewith. <input type="checkbox"/> the application identified above. <input checked="" type="checkbox"/> the patent identified above.</p> <p>I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license, any rights in the invention to any person who could not be classified as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).</p> <p>Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:</p> <p><input type="checkbox"/> No such person, concern or organization exists. <input checked="" type="checkbox"/> Each such person, concern or organization is listed below.</p> <p>*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities (37 CFR 1.27)</p>				
FULL NAME	Invent Engineering Pty Ltd			
ADDRESS	10 Macintyre Crescent, Sylvania, NSW 2224, Australia			
<input type="checkbox"/> Individual		<input checked="" type="checkbox"/> Small Business Concern	<input type="checkbox"/> Nonprofit Organization	
FULL NAME				
ADDRESS				
<input type="checkbox"/> Individual		<input type="checkbox"/> Small Business Concern	<input type="checkbox"/> Nonprofit Organization	
FULL NAME				
ADDRESS				
<input type="checkbox"/> Individual		<input type="checkbox"/> Small Business Concern	<input type="checkbox"/> Nonprofit Organization	
FULL NAME				
ADDRESS				
<input type="checkbox"/> Individual		<input type="checkbox"/> Small Business Concern	<input type="checkbox"/> Nonprofit Organization	

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF INVENTOR Sergi Yudanov

SIGNATURE OF INVENTOR 

DATE: 4 DECEMBER 2000

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

NAME OF INVENTOR _____

SIGNATURE OF INVENTOR _____

DATE: _____

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) AND 1.27 (c)) - SMALL BUSINESS CONCERN				Docket No. DCC-10003/04
Serial No. 08/693,138	Filing Date 11/12/96	Patent No. 5785921	Issue Date 07/28/98	
Applicant/ Patentee: Sergi Yudanov and William Richard Mitchell				
Invention: HYRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM				
<p>I hereby declare that I am:</p> <p><input type="checkbox"/> the owner of the small business concern identified below:</p> <p><input checked="" type="checkbox"/> an official of the small business concern empowered to act on behalf of the concern identified below:</p>				
<p>NAME OF CONCERN: Invent Engineering Pty Ltd</p> <p>ADDRESS OF CONCERN: 10 Macintyre Crescent, Sylvania, NSW 2224, Australia</p>				
<p>I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.</p>				
<p>I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the above identified invention described in:</p> <p><input type="checkbox"/> the specification filed herewith with title as listed above.</p> <p><input type="checkbox"/> the application identified above.</p> <p><input checked="" type="checkbox"/> the patent identified above.</p>				
<p>If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed on the next page and no rights to the invention are held by any person, other than the inventor, who could not qualify as an independent inventor under 37 CFR 1.9(c) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).</p>				

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

no such person, concern or organization exists.
 each such person, concern or organization is listed below.

FULL NAME Sergi Yudanov
 ADDRESS BERNHARDS GRÅND 7, LGM 30 GÖTEBORG 41342 SWEDEN
 Individual Small Business Concern Nonprofit Organization

FULL NAME _____
 ADDRESS _____
 Individual Small Business Concern Nonprofit Organization

FULL NAME _____
 ADDRESS _____
 Individual Small Business Concern Nonprofit Organization

FULL NAME _____
 ADDRESS _____
 Individual Small Business Concern Nonprofit Organization

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING: William RICHARD MITCHELL
 TITLE OF PERSON SIGNING: DIRECTOR, INVENT ENGINEERING Pty LTD
 OTHER THAN OWNER: _____
 ADDRESS OF PERSON SIGNING: 10 Macintyre Crescent
 Sylvania, NSW 2224
 AUSTRALIA

SIGNATURE: W. Mitchell DATE: 23 November 2000

HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM

TECHNICAL FIELD

The present invention relates to a system of injecting fuel into compression ignition internal combustion engines and preferably provides a means of reducing noise emission from such engines.

BACKGROUND ART

Some fuel injection systems have been designed as unit injectors which incorporate an hydraulically driven pressure intensifier with a stepped plunger for injecting fuel into the engine's cylinder and the fuel delivery and timing are controlled by an electronically controlled valve. also the spray pattern is controlled by means of modulating the base fuel pressure supplied to the unit injector. The present invention is similar to these unit injectors but improvements are added which are described herein which increase the injection pressure, decrease the amount of hydraulic energy required to drive and control the fuel injection system, improve the stability of fuel delivery in consecutive injections, reduce the minimum fuel delivery, allow for control of an injection pressure curve of the unit injector and improve its reliability. The present invention preferably also provides a method of reducing the noise level emanating from the engine.

The present invention concerns hydraulically actuated electronically controlled unit injection (HEUI) systems which are well known to the addressee. The closest art known to the present invention is that of SU-A-1671938, the contents of which are incorporated herein by references.

In a HEUI system, there is no cam for injection purposes and the fuel is supplied to the injectors under high pressure. The high pressure varies by means of a control signal from an engine management system and a top pressure may be 200 bars or around 3,000 psi and a bottom pressure could be 500 psi. The pressure is intensified within the injector. The fuel is then metered electronically and injected into the cylinder at pressures up to 27,000 psi or around 1800 bar.

The differences between the injector and injector system of the present invention and that of the Soviet specification mentioned above comprise firstly the inclusion of resilient means to bias an hydraulically controlled differential valve to its closed position; secondly, the inclusion of a throttling slot displaying the required characteristics. The Soviet specification reveals an hydraulic differential valve where the poppet end of that valve can close off the flow of fuel but in the present invention that part of the poppet and surrounds form a throttling slot with characteristics which alter the flow of fuel and alter the parameters under which the poppet will open or close. Specifically, the throttling slot provides a restriction such that the pressure in the poppet chamber is higher than the pressure in the working chamber in the injection part of the cycle and during the metering part of the cycle the throttling slot is designed to bring about a pressure difference which holds the HDV closed. The HDV in the Soviet design cannot carry out those functions due to the lack of a throttling slot and the lack of a by-pass channel between the control chamber and the poppet chamber.

DISCLOSURE OF INVENTION

In accordance with a first aspect of the present invention there is provided a fuel injector system for an internal combustion engine said injector system comprising an inlet

port; a spill port; a pressure intensifier comprised of a piston forming a working chamber and a plunger forming a compression chamber; a nozzle with a needle, a spring biasing the needle to close the nozzle, and an outlet chamber connected to the compression chamber; a non-return valve the inlet of the non-return valve being connected to the inlet port and the outlet of the non-return valve being connected to the compression chamber; an hydraulically controlled differential valve (HDV) having a seating face located between the inlet port and the working chamber, said HDV forming a control chamber which opens towards the working chamber, said HDV using a poppet opening into the working chamber upon release from the seating face, said poppet forming a fluid flow throttling slot and a poppet chamber, wherein a flow area of the throttling slot is up to 99% less than the flow area between the HDV and the seating face during a part of travel of the HDV said part of travel being up to 80% of full travel of the HDV, further wherein said poppet chamber is connected to the control chamber via a bypass channel between the poppet chamber and the control chamber; resilient means for biasing the HDV towards its closed position; a solenoid valve installed between the control chamber and the spill port.

In a second aspect the present invention consists in a fuel injector system for an internal system combustion engine said injector system comprising an inlet port; a spill port; a pressure intensifier comprised of a piston forming a working chamber and a plunger forming a compression chamber; a nozzle with a needle, a spring biasing the needle to close the nozzle, and an outlet chamber connected to the compression chamber; a non-return valve the inlet of the non-return valve being connected to the inlet port and the outlet of the non-return valve being connected to the compression chamber; an hydraulically controlled differential valve (HDV) having a seating face located between the inlet port and the working chamber, said HDV forming a control chamber and the HDV opens towards the working chamber, said HDV using a poppet opening into the working chamber upon release from the seating face, said poppet forming a fluid flow throttling slot and a poppet chamber, wherein a flow area of the throttling slot is up to 99% less than the flow area between the HDV and the seating face during a part of the travel of the HDV, said part of the travel being up to 80% of full travel of the HDV, further wherein said working chamber is connected to the control chamber via bore; resilient means for biasing the HDV towards its closed position; a solenoid valve installed between the control chamber and the spill port.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGS. 1 and 8 are longitudinal cross sectional views through an hydraulic unit fuel injector in accordance with a first embodiment of the present invention in different stages of operation;

FIG. 2 is a magnified view of a section of the hydraulically controlled differential valve of the injector of FIG. 1;

FIGS. 3-7, 9 and 10 are views similar to FIG. 1 but of different embodiments of injectors in accord with the present invention;

FIGS. 11 and 12 are views of another embodiment in different stages of operation; and

FIG. 13 is a longitudinal cross sectional view of a prior art injector of SU-A-1671938 with reference numerals coincident with those shown in that specification.

3

BEST MODES

The embodiment of FIG. 1 shows a source of fuel pressure 1, inlet port 2, spill port 3, hydraulically controlled differential valve (HDV) 4, control chamber 6, a pressure intensifier which is comprised of piston 7 and plunger 8, working chamber 9 and compression chamber 10, nozzle 11, needle 12, spring 13, locking chamber 14 and outlet chamber 15, non-return valve 16 the inlet of which is connected to the inlet port 2 and the outlet of which is connected to the compression chamber 10, solenoid valve 17 installed between the control chamber 6 and the spill port 3. The HDV controls an area for the flow of liquid (for simplicity we will hereinafter refer to such areas as flow areas) from the inlet port 2 to the working chamber 9 and opens towards the working chamber. Spring 18 tends to close the HDV.

Referring to FIG. 2, the HDV 4 has a differential spot 19 determined by the contact line 20 of the seating face 21 and the HDV and by the diameter of sealing cylindrical surface 22. The HDV has a poppet 23 which is located on the working chamber side with respect to the seating face 21. This poppet and the surface 24 surrounding it form the throttling slot 25, a flow area of which may vary with the movement of the HDV. There is a poppet chamber 27 comprised of poppet 23, surface 24, throttling slot 25 and a flow area between the HDV and seating face 21. Referring to FIG. 1, the poppet chamber 27 is connected to control chamber 6 via the bypass channel 5. The compression chamber 10 is connected with the outlet chamber 15. The compression chamber 10 may also be connected with the locking chamber 14 through the cut-off port 26 of the plunger 8 depending on the plunger's position.

An alternate form of the invention is shown in FIG. 3 which is identical to that shown in FIG. 1 except that there is the hole 28 to directly connect the control chamber 6 and the working chamber 9.

Another alternate form of the invention is shown in FIG. 4 which is identical to that shown in FIG. 3 except that the non-return valve 29 is installed in the hole or bore 28. The inlet of this non-return valve is connected to control chamber 6.

Another alternate form of invention is shown in FIG. 5 which is identical to that shown in FIG. 3 except that the sealing cylindrical surface 22 of the HDV 4 may change the flow area of the bypass channel 5 and close this channel off when moved along its axis.

Another alternate form of the invention is shown in FIG. 6 which is identical to that shown in FIG. 1 or FIG. 3 or FIG. 4 except that the control chamber 6 is connected to the inlet port 2 via bypass channel 30 and the sealing cylindrical surface 22 of the HDV 4 may change the flow area of the bypass channel 30 and close this channel off when moved along its axis.

Another alternate form of the invention is shown in FIG. 7 which is identical to that shown in FIG. 3 except that a connection between the poppet chamber 27 and the control chamber 6 is absent and the control chamber 6 is connected to the inlet port 2 through the channel 30, wherein the sealing cylindrical surface 22 of the HDV 4 may change the flow area of the channel 30 and close it off when moved along its axis.

Another form of invention is shown in FIG. 9 which is similar to those shown in FIGS. 1-7 except that an additional adjustable valve 31 is installed, which is capable of varying the flow area of the bypass channel 5. Said valve 31 may also be implemented in the other forms of the invention.

shown in FIGS. 1, 3, 4, 6, 7 to vary the flow areas of the channel 5 or 30.

Another form of the invention is shown in FIG. 10 which is identical to the ones described before except that the flow area of the non-return valve 16 may be controlled mechanically by the pressure intensifier with the purpose of improving the reliability of the operation of the unit injector. The design and a principle of operation of this form of the invention will be described in greater details later.

Another form of the invention is shown in FIGS. 11-12, which is similar to that shown in FIG. 10 except that a spring 37 is added.

The fuel injection system works as follows—Referring to FIG. 1, in the initial position the solenoid valve 17 is inert and closes off the connection between control chamber 6 and spill port 3. The HDV 4 is closed, the piston 7 and plunger 8 are kept in the bottom position by the fuel pressure in the working chamber 9, the locking chamber 14 is connected via the plunger's cut-off port 26 with compression chamber 10 and the nozzle 11 is closed by the needle 12.

Referring to FIG. 8, when electric current is supplied to electric valve 17 it opens and allows the fuel to flow from the working chamber 9 through the throttling slot 25 to poppet chamber 27, further through the bypass channel 5 to control chamber 6 and out through the spill port 3. The flow area of the throttling slot 25 is such that said flow through it causes the hydraulic force to act on the HDV in the direction of the flow which holds the HDV closed with the additional assistance of the force exerted by the spring 18. When pressure in the working chamber 9 has decreased to a certain level piston 7 and plunger 8 move up under the pressure in the compression chamber 10, the fuel pressure being transmitted through the non-return valve 16. At a certain point in the travel of the plunger its cut-off port 26 closes the connection between compression chamber 10 and locking chamber 14 and whilst at or beyond that point it isolates the chambers 10 and 14 from each other. The period of time during which piston 7 and plunger 8 move up is determined by the duration of opening of the solenoid valve 17 which is in turn determined by the duration of the current supplied by the engine management system (not shown). When piston 7 and plunger 8 have reached the required position which is determined by the fuel delivery required at that instant, the current is switched off by the engine management system and the electric valve closes thereby isolating the control chamber 6 and spill port 3. As a result, the fuel flow via the throttling slot 25 stops and the hydraulic force holding HDV 4 closed ceases to act. The pressure in the fuel transmitted through inlet port 2 and to the differential spot in the HDV overcomes the force of spring 18 and provides an initial opening of the HDV (Ref. FIG. 3). This allows fuel to flow through the inlet port 2 to the poppet chamber 27 and via the throttling slot 25 to the working chamber 9 and via the bypass channel 5 to control chamber 6. The pressure in the working chamber 9 rises and causes the piston 7 and the plunger 8 to move down thereby compressing the fuel in the compression chamber 10 and closing the non-return valve 16.

Referring to FIG. 2, the poppet 23 and the surface 24 surrounding it are designed in such a way that the flow area of the throttling slot 25 may be less (typically up to 99% less) than the flow area between the HDV 4 and the seating face 21 while the HDV 4 is located between its closed position and a certain position between its closed and fully open positions (further down we will define the state of the HDV when it is located between the closed and said certain

positions as the initial travel of the HDV). Therefore during the initial travel of the HDV (Ref. FIG. 3) the pressures in the poppet chamber 27 and control chamber 6 may be kept higher than the pressure in the working chamber 9. The pressures in the control 6 and poppet 27 chambers act on the HDV 4 and its poppet 23 respectively and help the HDV to open (i.e. to increase the flow area between the HDV and seating face 21) at a faster rate. Said initial travel of the HDV may typically take up to 80% of the full stroke of the HDV. In the preferred embodiment, as shown in FIG. 2, the throttling slot 25 is formed by the clearance between the poppet 23 and the surface 24, said clearance remains constant during the initial travel of the HDV. On the final part of the opening stroke of the HDV the flow area of the throttling slot 25 increases (Refer FIG. 7), in order to decrease hydraulic resistance to the fuel flow. In the preferred embodiment, when the HDV is fully open the resistance to the flow through the throttling slot 25 has decreased to the value such that it provides the hydraulic force which is equal to the force exerted by the spring 18 but opposite in its direction.

As the fuel pressure in compression chamber 10 increases, the pressure in the nozzle's outlet chamber 15 also increases and opens the nozzle, overcoming the force of spring 13 and pressure in the locking chamber 14 and lifting needle 12 off its seat. During an injection stroke of the piston 7 and plunger 8 fuel is injected through opened nozzle 11. When the plunger 8 reaches the position where it opens its cut-off port 26 the pressures in compression chamber 10 and locking chamber 14 equalise and the needle 12 closes nozzle 11 and the piston 7 and plunger 8 stay at the bottom of the stroke. When the piston is stationary there is no fuel flow through the HDV and the pressures in the working chamber 9, poppet chamber 27 and control chamber 6 equalise with the pressure in the inlet port 2 and the spring 18 moves the HDV up and closes it. Thus the system returns to the initial position as shown in FIG. 1.

In an alternate form of the invention (Ref. FIG. 3) the fuel injection system works in the same way. The total flow area of the throttling slot 25 and the hole 28 is chosen such that it provides sufficient resistance to the fuel flow from the working 9 to control 6 chambers to hold the HDV closed with the open solenoid valve 17.

In an alternate form of the invention shown in FIG. 4 the fuel injection system works in the same way. When the piston and plunger stop at the end of the injection stroke and pressures in the inlet port 2 and working chamber 9 equalise, the spring 18 closes HDV 4. During its movement to the closed position the positive pressure difference between the control chamber 6 and working chamber 9, developed by the spring 18, opens non-return valve 29. By this means the total flow area of the path, connecting the working chamber 9 with the control 6 and poppet 27 chambers, may be increased at the time when the HDV 4 is being closed, therefore the time required to close the HDV, is reduced.

In another alternate form of invention shown in FIG. 5, with the HDV 4 in the closed position the bypass channel 5 is closed by the sealing cylindrical surface 22 of the HDV and there is an overlap "L". The fuel injection system works in the same way as the one shown in FIG. 1, but when the solenoid valve 17 is open and fuel flows from the working 9 to control 6 chamber, the flow rate does not depend on the flow area of throttling slot 25, therefore the fuel delivery of the injection system is less affected by the tolerances on the dimensions of the throttling slot 25.

In another form of the invention shown in FIG. 6 the fuel injection system works in the same way as the one shown in

FIG. 1 or FIG. 3 or FIG. 4 with the open solenoid valve 17. Also similarly, after the electric valve has closed, the hydraulic forces act on the HDV and opens it. At the certain position of the HDV its sealing cylindrical surface 22 opens the bypass channel 30. By this means the pressure in the control chamber 6 during the opening stroke of the HDV is increased, therefore the HDV opens at a faster rate.

In another form of the invention shown in FIG. 7 the fuel injection system works in the same way as the one shown in FIG. 5. Also similarly, when the solenoid valve 17 closes the hydraulic forces acting on the differential spot 19 and the poppet 23 open the HDV. At a certain position of the HDV its sealing cylindrical surface 22 opens the bypass channel 30. By this means the pressure in the control chamber 6 during the opening stroke of the HDV is increased, therefore the HDV opens at a faster rate.

In another form of the invention shown in FIG. 9 the fuel injection system works in the same way as the ones described before. The flow area of the bypass channel 5 may be varied with the additional adjustable valve 31. By this means a pressure in the control chamber 6 during an opening stroke of the HDV 4 may be controlled, therefore the speed of the opening stroke of the HDV may be controlled.

In another form of the invention shown in FIG. 10 the fuel injection system works in the same way as the ones described before but the flow area of the non-return valve 16 is controlled by the pressure intensifier such that when the fuel injection system is in its initial position the non-return valve is closed mechanically by the plunger 8. The non-return valve 16 in one embodiment comprises a locking element in the form of a ball 32, a return spring 33, a spacer 34 with a connection spring 35 attached to said spacer, and a stopper 36. When the pressure intensifier is in its initial position, the plunger 8 compresses the connection spring 35 such that said spring exerts the force through the spacer 34 on the ball 32 which is greater than the hydraulic force acting on said ball from the pressure in the inlet port 2, therefore the non-return valve is in a closed state. When the solenoid valve 17 opens and the pressure in the working chamber 9 decreases, as described above, the plunger 8 starts to move up under the force of the connection spring 35 and an hydraulic force of the pressurised fuel trapped in the compression chamber 10 after the previous injection cycle. During this upward movement of the plunger it releases the connection spring 35 and when the pressure in the compression chamber 10 falls below the pressure in the inlet port 2 the non-return valve 16 opens under the pressure in the inlet port 2, as shown in FIG. 12. An additional return spring 37 may be installed under the piston 7, as shown in FIGS. 11 and 12, to assist the initial upward movement of the plunger 8. As long as said spring 37 is required only for initial upward movement of the plunger 8 and it is not necessary to maintain a contact between said spring 37 and the piston 8 during all upward travel of the intensifier, it can be of a shortened free length as shown in FIG. 12 in order to save the dimensions.

There is another element to this invention as follows—
Direct injected diesel engines are more efficient than indirect injected types, but direct injected diesel engines suffer from a relatively high noise level at low speed and load and particularly at idle. The main source of that noise is a rapid increase in pressure within the cylinder as a result of a prolonged delay before ignition of the injected fuel occurs. The prolonged ignition delay results in a considerable amount of fuel having been injected and prepared for ignition (mixed with air, vapourised, heated) prior to ignition so that when ignition occurs the amount of heat released, and

therefore the increase of the pressure within the cylinder, in relation to the crank angle is high. One of the reasons for the increased ignition delay at low speed and load is the relatively low temperature of the combustion chamber at those conditions so that the process of the heating of the fuel to a specific temperature takes a longer time.

One basic method to eliminate this phenomenon is to structure the process of fuel injection so that the rate of increase of injection pressure (therefore the rate of actual fuel injection) at the beginning of the process is reduced and this is done by causing the leading front of the injection pressure curve to have something of a "stepped" shape. A small part of the fuel to be injected is injected at the beginning of the injection cycle over a relatively long period of time with the purpose of providing an ignition of this pilot fuel portion thereby ensuring that the rest of the fuel injected on that cycle is injected into media with a higher temperature and this results in a reduced rate of heat release.

At higher speeds and also high engine loads it is necessary to provide very short durations of injection process to achieve proper heat utilisation and low emission of pollutants and this requires a higher rate of increase of fuel injection pressure. This is particularly important for turbocharged diesel engines featuring high boost levels and with large bore sizes because the high injection pressure developed during the ignition delay allows the fuel spray to permeate the whole combustion chamber before the media in it is compressed significantly by the burning fuel. It is desirable that a variable range of fuel injection pressures should be provided to allow for this condition and bring about complete utilisation of the charge air.

According to the described method, if a low noise level, high efficiency and low emission of pollutants of the diesel engine are to be achieved under the various operating regimes, it is necessary that the fuel injection system should be able to control the shape of the injection pressure curve over a wide range and with the engine running. It is likely that the design of a fuel injection system with the necessary abilities and flexibility will have an unacceptably high cost, complexity and low reliability.

This invention presents a new method of reducing the noise level emanated from the combustion process of the diesel engine at acceptable cost and reliability. According to this new method, a pilot amount of fuel is injected into the cylinder well before the top dead centre of the compression stroke. Typically it can be injected any time from the moment of the exhaust valve's closure to this TDC, as long as enough time has been left for the fuel injection system to get prepared for the main injection which delivers the main part of the total amount of fuel required at given operating conditions of the diesel engine. Therefore this method allows for control of the noise emission from the diesel engine by means of control of injection timing and fuel delivery only and does not require the fuel injection system to have the ability to control the shape of the injection pressure curve.

It is necessary that the quantity of fuel of the pilot injections be very small to avoid inferior performance from the engine. The design of the fuel injection system described herein provides great flexibility and very wide ranges of control of injection timing and fuel delivery and is capable of injecting small enough amounts of pilot fuel to make it possible to implement a new method of reducing the engine's noise by controlling the amount of fuel and injection timing for both pilot and main injections independently of each other.

The advantages of the present invention over known fuel injection systems are achieved mainly by the following means:

- the application of the spring 18;
- the application of the throttling slot 25 designed in such a way that during the initial travel of the HDV the flow area of this slot may be less than the flow area between the HDV and the seating face 21;
- the application of the bypass channel 5 connecting the poppet chamber 27 to control chamber 6;
- the application of the additional adjustable valve 31;
- the application of the non-return valve 16 as shown in FIGS. 10-12, the flow area of which may be controlled by the pressure intensifier.

In the absence of spring 18 the HDV may be closed by the positive pressure difference between the working 9 and control 6 chambers caused by the flow from the working chamber through the control chamber and open electric valve to the spill port 3. Such an HEUI is shown in SU Patent No. 1,671,938 WPI Acc No. 92-347048/42. In that case during the process of closing the HDV fuel flows through semi-opened HDV from the inlet port 2 to the working chamber 9 and further to the spill port 3. The application of the spring 18 eliminates this waste of hydraulic energy because said spring closes the HDV 4 with the solenoid valve 17 closed, as described above. Also, the application of the spring 18 provides a better stability of fuel delivery in consecutive injections, especially with small fuel deliveries. In the case of a design without a spring 18 the HDV is being closed during the period when electric current is turned on. As the durations of the closures of the HDV differ from cycle to cycle due to, for example, random changes in the force of friction in the sealing cylindrical surface 22 of the HDV, the parts of the full electric impulses which remain to execute the reverse (filling) stroke of the plunger and piston are different, which causes corresponding variations in fuel deliveries. As long as the spring 18 in the present invention closes the HDV before the electric current is turned on, the reverse (filling) stroke of the plunger and piston are always determined by the full duration of the electric impulse supplied by an engine management system without any random variation. This ensures better stability of fuel delivery in consecutive injections.

The application of the throttling slot 25, the flow area of which may be less than the flow area between the HDV 4 and seating face 21, allows higher pressure to build in the poppet chamber 27 during the opening of the HDV, which forces it to open at a faster rate. The application of the bypass channels 5, 30 allows higher pressure to build in the control chamber 6 during this period and also increases the opening rate of the HDV. Faster opening of the HDV decreases its overall hydraulic resistance during the period of the injection, and therefore increases the injection pressure.

The application of the additional adjustable valve 31 as shown in FIG. 9 allows for control of a speed of the opening stroke of the HDV 4. By this means it is possible to control the shape of an injection pressure curve of the unit injector during its operation. This can help to increase the efficiency of research work on diesel engines.

The application of the non-return valve 16 (Ref. FIGS. 10-12), the flow area of which may be controlled by the pressure intensifier, improves reliability of the unit injector. In case of insufficient sealing between the tapered end of the needle 12 and the nozzle 11, the non-return valve 16 which is closed by the plunger 8 prevents a flow of fuel from the

inlet port 2 to the cylinder of an engine. Otherwise such flow of fuel can cause significant waste of fuel, smoke emission, contamination of the engine's oil and even a failure of the engine.

Poor sealing in the nozzle leads to a significant increase in the emission of pollutants of the exhaust gases of a diesel engine in any case. A method of avoiding such increase in pollution where poor nozzle sealing occurs will now be described.

The method according to present invention is based on the ability of the injection system to provide an additional means for closing the fuel flow path from the inlet port to the cylinder of an engine. When poor nozzle sealing occurs in one of the cylinders of the diesel engine during its operation, an engine management system detects it and stops the supply of control impulses to the failed unit injector. Then the pressure intensifier of this unit injector is kept in the bottom position by the fuel pressure in the working chamber at all times, thereby closing the non-return valve 16 according to FIGS. 10-12 and preventing fuel in the inlet port 2 from entering the compression chamber 10 and the engine's cylinder. By this means a vehicle is allowed to reach a service station with this cylinder not working but without extensive damage to the environment.

In order to enable the engine management system to detect the cylinder which is causing excessive pollution a sensor of the temperature of the exhaust gases can be used, because a fuel leakage from the faulty nozzle will cause not only an increased emission of smoke, but also an increase in the exhaust temperature. If only one temperature sensor is used in the common exhaust pipe, the engine management system can be programmed to find the faulty cylinder by shutting down each cylinder in turn and measuring exhaust temperatures on each of these steps.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.

We claim:

1. A fuel injector system for an internal combustion engine said injector system comprising an inlet port; a spill port; a pressure intensifier comprised of a piston forming a working chamber and a plunger forming a compression chamber; a nozzle with a needle, a spring biasing the needle to close the nozzle, and an outlet chamber connected to the compression chamber; a non-return valve the inlet of the non-return valve being connected to the inlet port and the outlet of the non-return valve being connected to the compression chamber; an hydraulically controlled differential valve (HDV) having a seating face located between the inlet port and the working chamber said HDV forming a control chamber and the HDV opens towards the working chamber, said HDV using a poppet opening into the working chamber upon release from the seating face, said poppet forming a fluid flow throttling slot and a poppet chamber, wherein a flow area of the throttling slot is up to 99% less than the flow area between the HDV and the seating face during a part of the travel of the HDV, said part of the travel being up to 80% of full travel of the HDV, further wherein said poppet chamber is connected to the control chamber via a bypass channel; resilient means for biasing the HDV towards its closed position; a solenoid valve installed between the control chamber and the spill port.

2. A fuel injector system for an internal combustion engine said injector system comprising an inlet port; a spill

port; a pressure intensifier comprised of a piston forming a working chamber and a plunger forming a compression chamber; a nozzle with a needle, a spring biasing the needle to close the nozzle, and an outlet chamber connected to the compression chamber; a non-return valve the inlet of the non-return valve being connected to the inlet port and the outlet of the non-return valve being connected to the compression chamber; an hydraulically controlled differential valve (HDV) having a seating face located between the inlet port and the working chamber, said HDV forming a control chamber and the HDV opens towards the working chamber, said HDV using a poppet opening into the working chamber upon release from the seating face, said poppet forming a fluid flow throttling slot and a poppet chamber wherein a flow area of the throttling slot is up to 99% less than the flow area between the HDV and the seating face during a part of the travel of the HDV, said part of the travel being up to 80% of full travel of the HDV, further wherein said working chamber is connected to the control chamber via a bore; resilient means for biasing the HDV towards its closed position; a solenoid valve installed between the control chamber and the spill port.

3. A fuel injector according to claim 1 [or 2], wherein the flow area of the throttling slot remains constant during the part of the travel of the HDV.

4. A fuel injector according to claim 1 wherein the working chamber is connected to the control chamber via a bore.

5. A fuel injector according to claim [2] 4, wherein a further non-return valve is installed in the bore, the inlet of said further non-return valve being connected to the control chamber.

6. A fuel injector according to claim 4 wherein a sealing cylindrical surface of the HDV is adapted to change the flow area of the bypass channel and close off the bypass channel depending on the axial position of the HDV.

7. A fuel injector according to claim 1 wherein the control chamber is connected to the inlet port via a channel and a sealing cylindrical surface of the HDV is adapted to vary the flow area of the channel and close off a channel in dependence on the axial position of the HDV.

8. A fuel injector according to claim 4 wherein the connection between the poppet chamber and control chamber is closed and the control chamber is connected to the inlet port with a channel and the sealing cylindrical surface of the HDV varying the flow area of the channel and adapted to close off the channel depending on the axial position of the HDV.

9. A fuel injector according to claim 1 wherein the non-return valve is adapted to be mechanically closed by a pressure intensifier.

10. A fuel injector according to claim 9 wherein resilient means is placed between the plunger and a locking element of the non-return valve such that when the pressure intensifier is in the bottom position the plunger closes the non-return valve transmitting a force required to close said valve through the resilient means.

11. A method of improving the reliability of a diesel engine equipped with a fuel injector [wherein] such that when there is an incomplete closing of a [fluid] fuel injection nozzle in one of the engine's cylinders [causes] an engine management system [to stop] stops supplying the injector of said one cylinder with electric control impulses, [whereby] and wherein a pressure intensifier in the fuel injector permanently closes off [the] a non-return valve, to thereby [preventing] prevent access of pressurised fuel to the [unsealed] incompletely closed nozzle[, which otherwise will cause significant increase in smoke emission and exhaust gas temperature of the engine or its breakdown].

11

12. A fuel injector according to claim 7 comprising an additional adjustable valve adapted to vary the flow area of the bypass channel or the channel.
13. A fuel injector according to claim 8 comprising an additional adjustable valve adapted to vary the flow area of the bypass channel or the channel.
14. A fuel injector according to claim 9 wherein additional resilient means is placed beneath the piston [to exert a force on the piston] to exert a force on the piston in the direction of upward movement of the piston.

on the piston to exert a force on the piston in the direction of upward movement of the piston.

15. A fuel injector according to claim 10 wherein additional resilient means is placed beneath the piston to exert a force on the piston [to exert a force on the piston] in the direction of upward movement of the piston.

16. A fuel injector according to claim 2, wherein the flow area of the throttling slot remains constant during the part of the travel of the HDV.

17. A fuel injector according to claim 2, wherein the control chamber is connected to the inlet port via a channel and a sealing cylindrical surface of the HDV is adapted to vary the flow area of the channel and close off a channel in dependence on the axial position of the HDV.

18. A fuel injector according to claim 2, wherein the non-return valve is adapted to be mechanically closed by a pressure intensifier.

19. A method of reducing the noise emanating from a diesel engine, wherein a fuel injection system delivers an amount of fuel required at a given operating condition of the engine for each combustion stroke in two or more stages being a pilot injection(s) and a main injection, said fuel injection system reaches its initial position between those stages, wherein the pilot injection(s) may occur at any instant from the closure of the exhaust valve of the cylinder to the last moment which leaves enough time for the fuel injection system to prepare for the main injection, said main injection occurring in the vicinity of top dead center of the compression stroke of the engine.

* * * * *

A hydraulically actuated electronically controlled unit injection system comprises a pressure intensifier associated with a hydraulically controlled differential valve (HDV) having a poppet valve opening into a working chamber of the pressure intensifier wherein there is a throttling slot between the poppet valve chamber and the working chamber with either at least a bypass channel between the poppet valve chamber and the working chamber or a bore connecting the working chamber to a control chamber of the HDV.

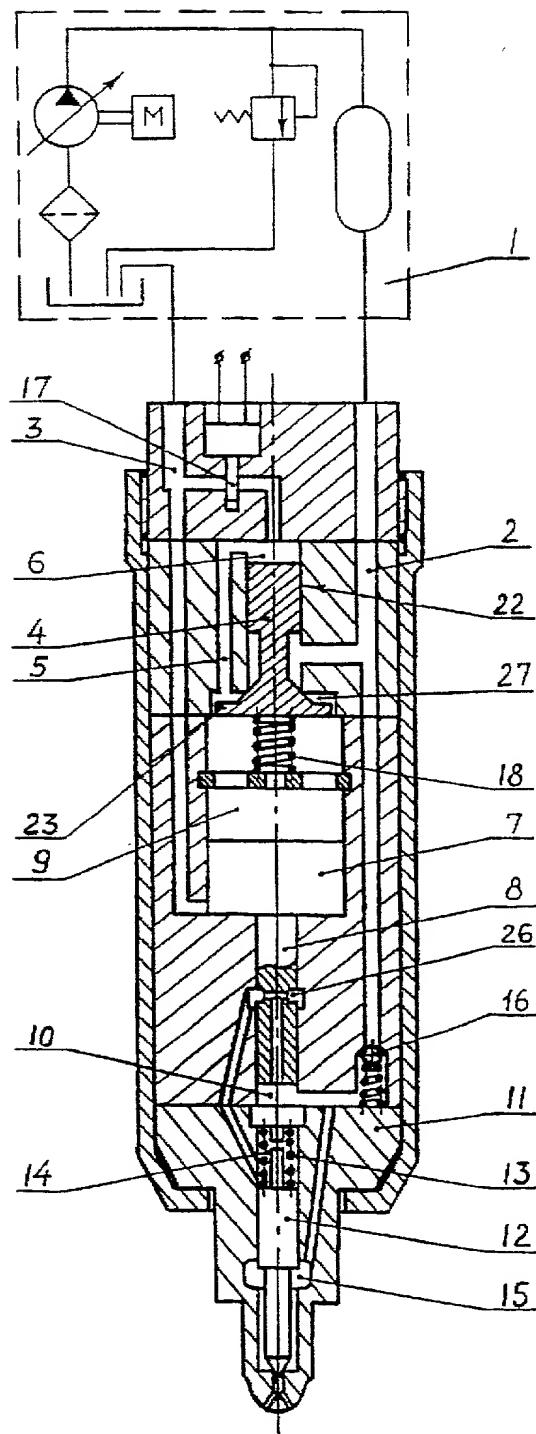


Fig. 1

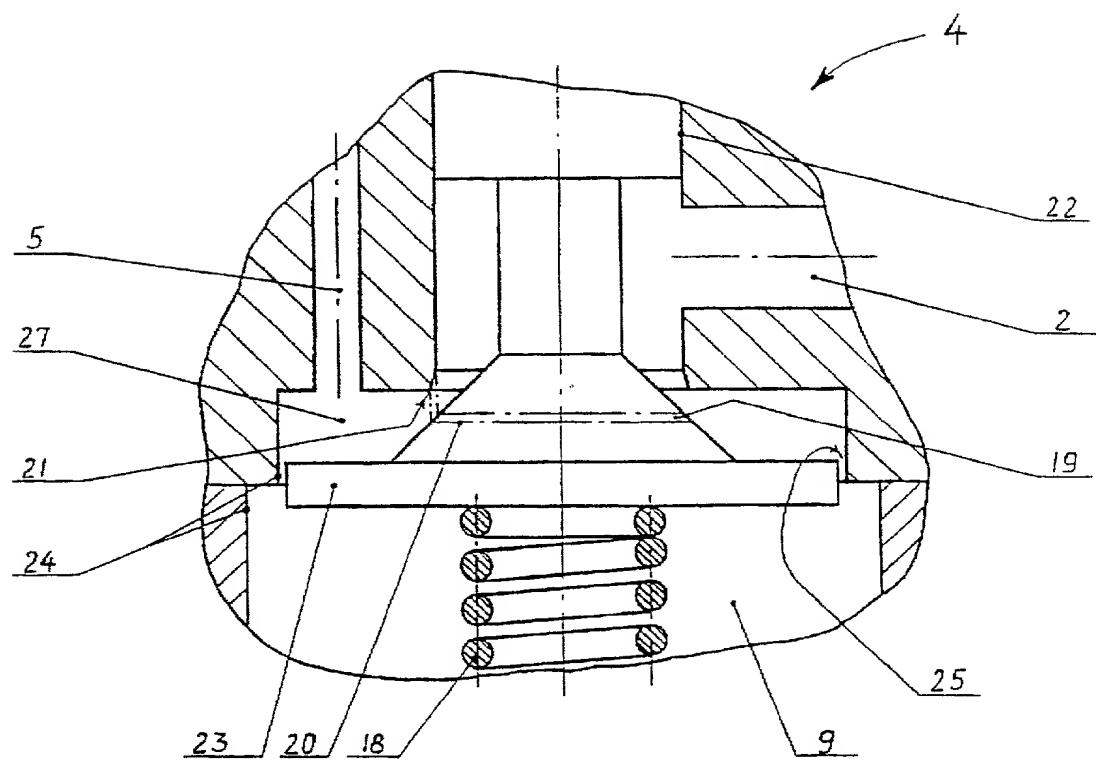


Fig. 2

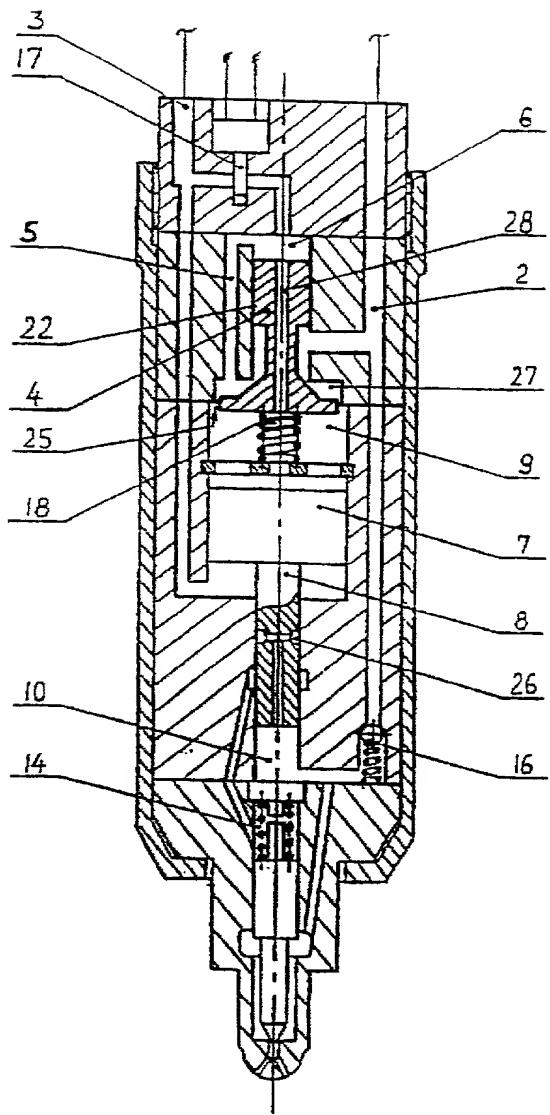


Fig. 3

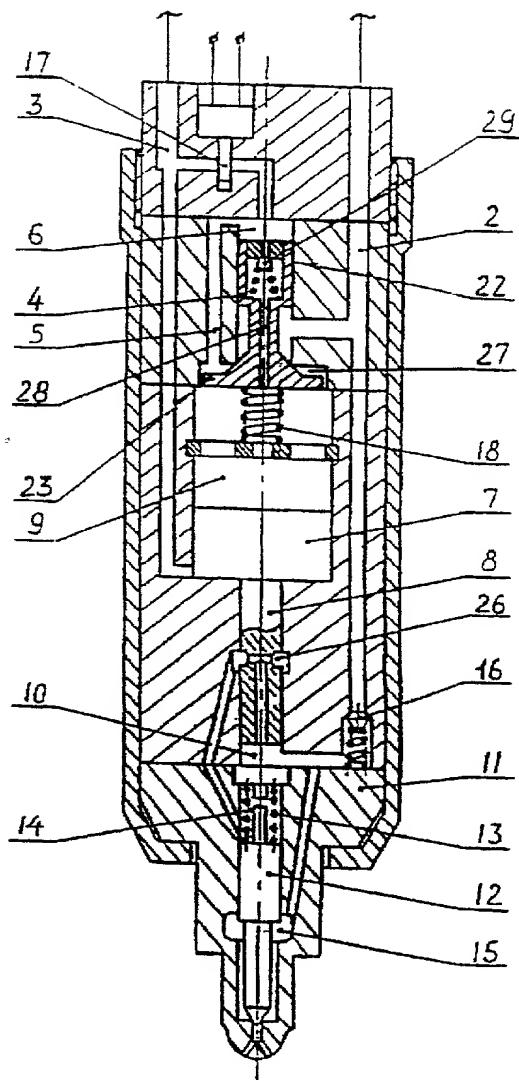


Fig. 4

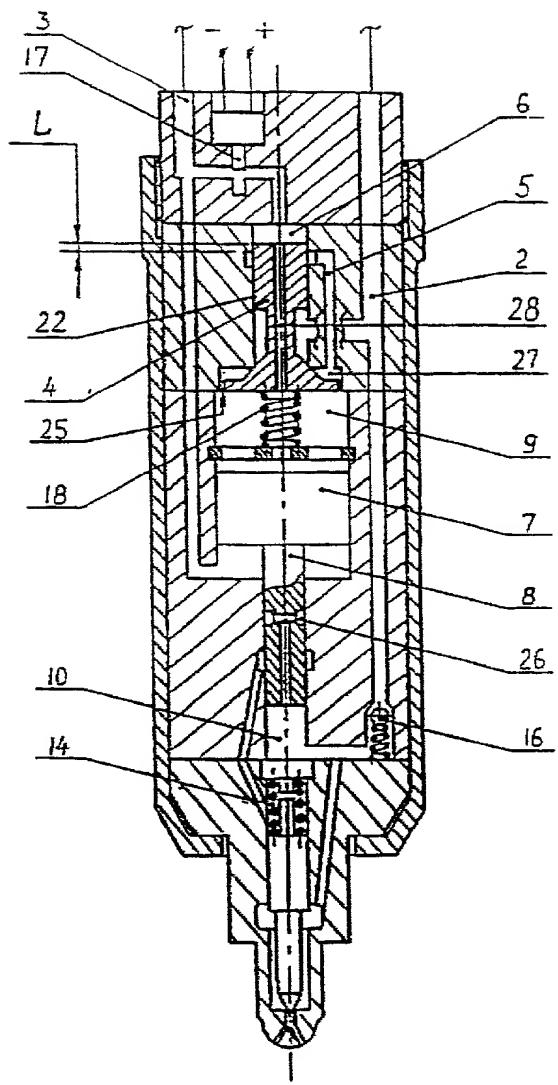


Fig. 5

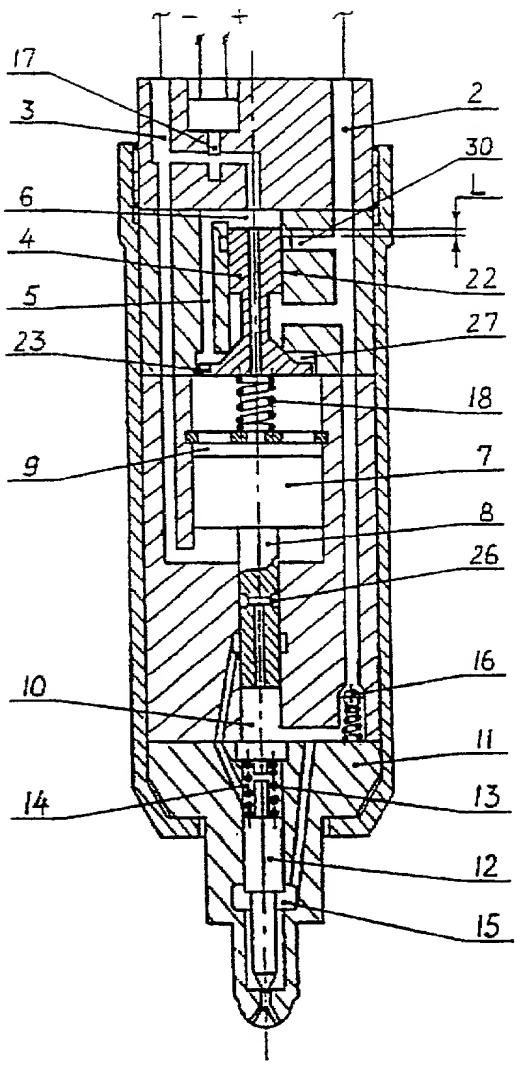
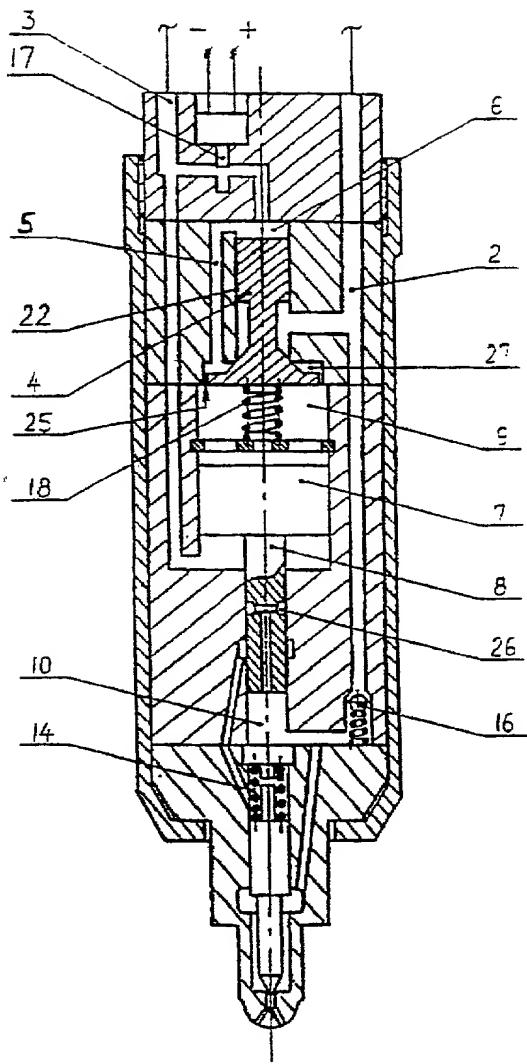
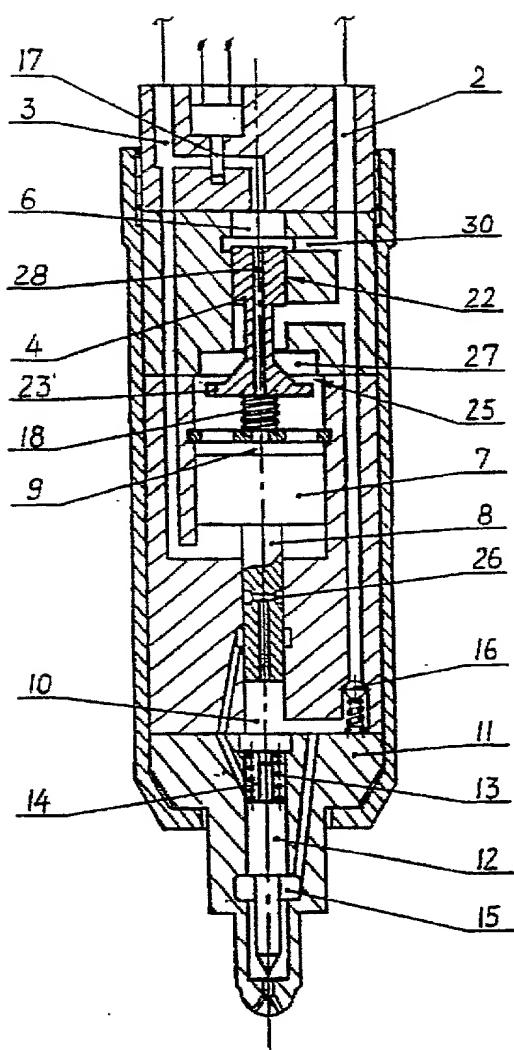


Fig. 6



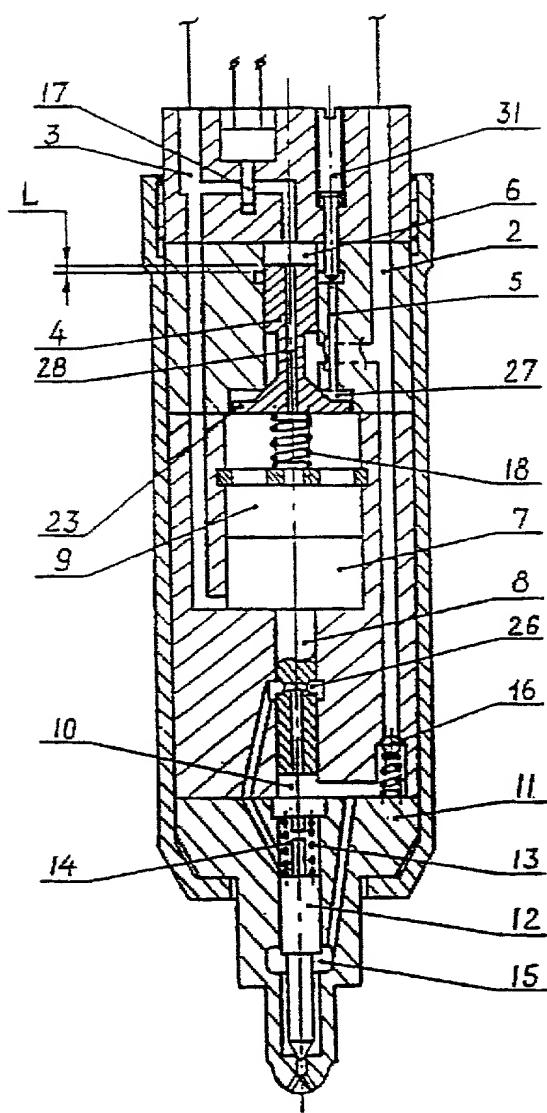


Fig. 9

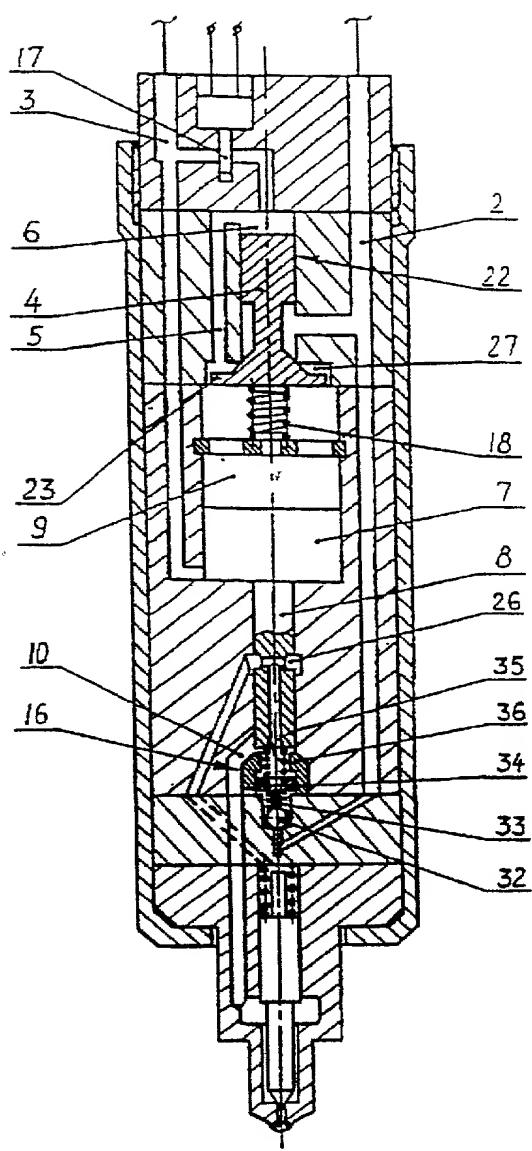


Fig. 10

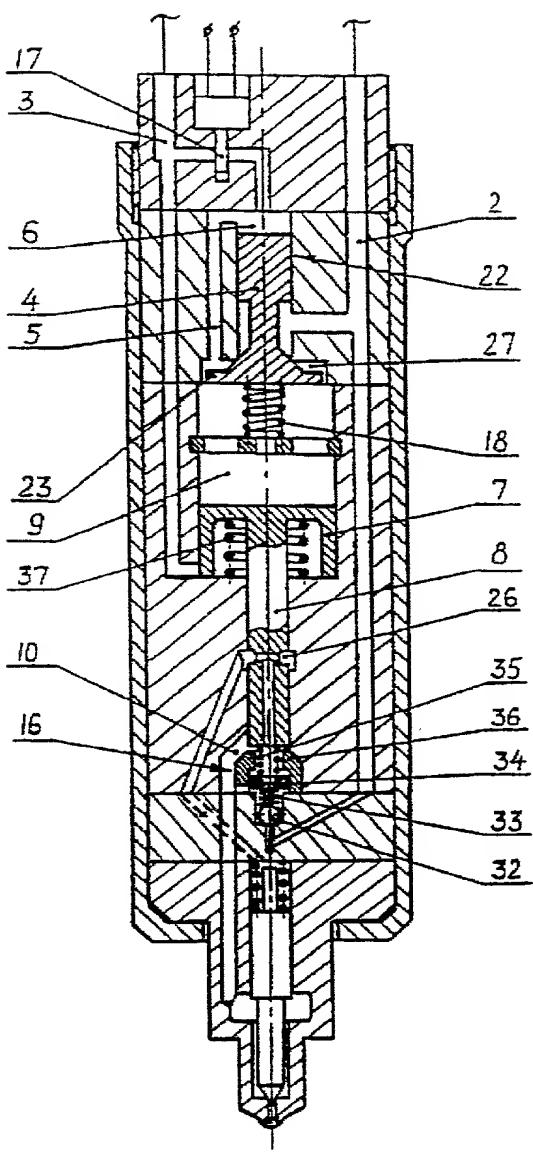


Fig. 11

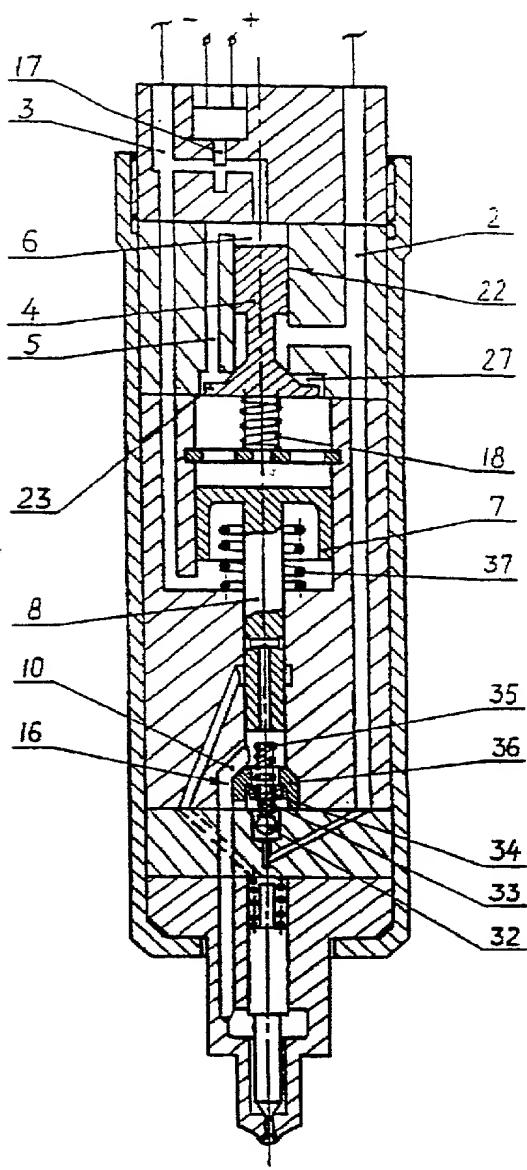


Fig. 12

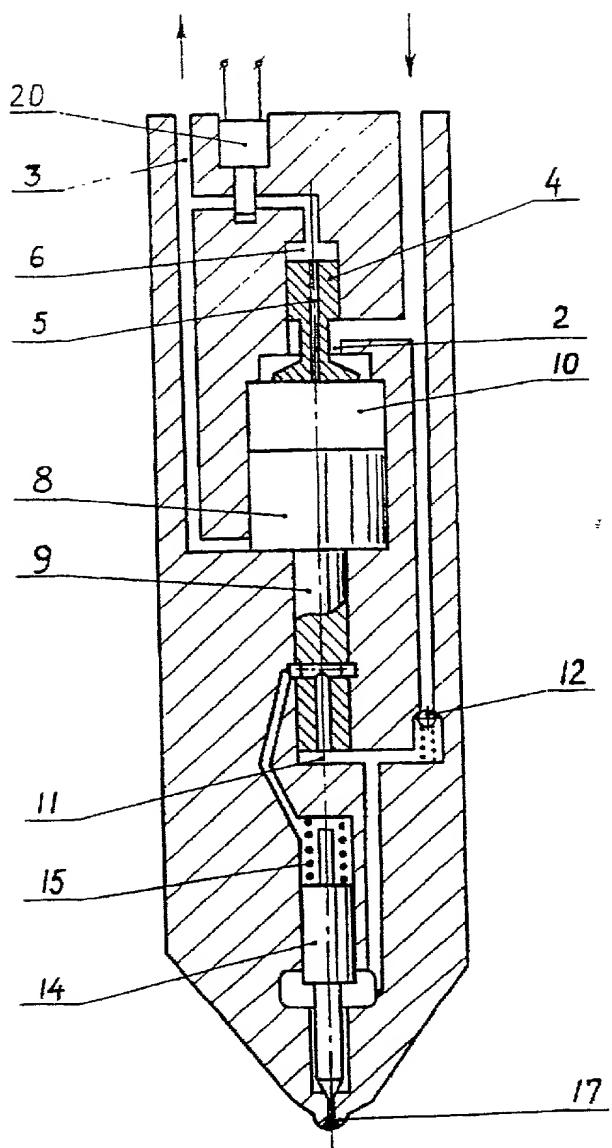
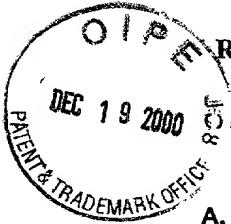


Fig. 13



**REISSUE APPLICATION DECLARATION AND POWER OF ATTORNEY
(BY INVENTOR(S) OR ASSIGNEE)**

(complete A or B)

A. DECLARATION BY THE INVENTOR(S)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter that is described and claimed in letters patent number 5,785,021, granted on 7/28/98, and for which invention I solicit a reissue patent on the invention entitled HYDRAULICALLY ACTUATED ELECTRONIC FUEL

INJECTION SYSTEM

the specification of which

- is attached hereto.
- was filed on _____, as reissue application number / and was amended on _____ (*if applicable*).
- I hereby declare that there is no assignee for this application.

NOTE: "Where no assignee exists, applicant should affirmatively state that fact. If the file record is silent as to the existence of an assignee, it will be presumed that no assignee exists." M.P.E.P., 6th ed., rev. 1, § 1410.01.

B. DECLARATION BY ASSIGNEE

NOTE: The assignee of the entire interest may make the declaration, if the reissue application does not seek to enlarge the scope of the claims of the original patent. 37 C.F.R. § 1.172.

(type or print name of declarant) _____, Title _____
of _____, Name of company or legal entity on whose behalf declarant is authorized to sign
declare that I am a citizen of _____ and resident of _____,
_____, that the entire title to letters patent number _____,
for _____, granted on _____, 19____ to _____
Inventor(s) _____

is vested in _____, Name of company or legal entity _____

that I believe said named inventor(s) to be an original, first and sole inventor (*if only one name is listed*) or an original, first and part inventor (*if plural names are listed*) of the subject matter that is described and claimed in the aforesaid letters patent and in the foregoing specification and for which invention I solicit a reissue patent.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR
(37 C.F.R. § 1.175)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

In compliance with this duty, there is attached an information disclosure statement in accordance with 37 C.F.R. § 1.98.

PRIORITY CLAIM

NOTE: A "claim" for the benefit of an earlier filing date in a foreign country under 35 U.S.C. 119(a)-(d) must be made in a reissue application even though such a claim was made in the application on which the original was granted. However, no additional certified copy of the foreign application is necessary. M.P.E.P., 6th ed., rev. 1, § 1417.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete C or D)

C. No such applications have been filed.
D. Such applications have been filed as follows:

**EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION**

Country	Application No.	Date of filing (day, month, year)	Date of issue (day, month, year)	Priority Claimed
PCT	AU95/00073	15/02/95		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>
AU	PM 3876	15/02/94		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>
AU	PN 0176	21/12/94		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION**

BENEFIT OF PROVISIONAL APPLICATION

**STATEMENT OF INOPERATIVENESS
OR INVALIDITY OF ORIGINAL PATENT**
(37 C.F.R. § 1.175)

That I believe the original patent to be

partly
 wholly

inoperative or invalid by reason of (37 C.F.R. § 1.175(a)(1)):

(check all items that may apply)

a defective specification
 a defective drawing
 the patentee claiming more or less than the patentee had a right to claim in the patent.

NOTE: At least one error must be relied upon as the basis for the reissue. 37 C.F.R. § 1.175(a)(1).

That the error listed above, which are being corrected, up to the time of the filing of this reissue declaration arose without any deceptive intention on the part of the applicant. (37 C.F.R. § 1.175(a)(2).

NOTE: For any error corrected not covered by this declaration applicant must submit, before allowance, a supplemental declaration stating that every such error arose without any deceptive intention on the part of the applicant. 37 C.F.R. § 1.175(b)(1).

Corroborating affidavits or declarations of others accompany this declaration.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

(check the following item, if applicable)

- I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO: (Name and telephone number)

Address

248-647-6000

Douglas W. Sprinkle
Gifford, Krass, Groh, Sprinkle
Anderson & Citkowski, P.C.
280 N. Old Woodward, Suite 400
Birmingham, MI 48009

Customer Number 25006

(Reissue Application Declaration and Power of Attorney [17-6]—page 4 of 6)

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

BY THE INVENTOR(S)

Full name of sole or first inventor Sergi Yudanov

Inventor's signature S. Yudanov

Date 14 DECEMBER 2000 Country of Citizenship Australia

Residence _____

Post Office Address _____

Full name of second joint inventor, if any William Richard Mitchell

Inventor's signature W. Mitchell

Date 23 NOVEMBER 2000 Country of Citizenship Australia

Residence _____

Post Office Address _____

BY ASSIGNEE OR PERSON AUTHORIZED TO SIGN ON BEHALF OF ASSIGNEE

NOTE: Even though inventor(s) do not sign, complete above information for inventor(s).

(complete the following, if applicable)

(type name of assignee) _____

Address of assignee _____

Title of person authorized to sign on behalf of assignee _____

Assignment recorded in PTO on _____

Reel _____

Frame _____

A separate "ASSIGNMENT (DOCUMENT) COVER SHEET"

or FORM PTO 1595 is submitted herewith along with the assignment _____

**REISSUE APPLICATION DECLARATION AND POWER OF ATTORNEY
(BY INVENTOR(S) OR ASSIGNEE)***(complete A or B)***A. DECLARATION BY THE INVENTOR(S)**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (*if only one name is listed below*) or an original, first and joint inventor (*if plural names are listed below*) of the subject matter that is described and claimed in letters patent number 5,785,021, granted on 7/28/98, and for which invention I solicit a reissue patent on the invention entitled HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM

the specification of which

is attached hereto.

was filed on _____, as reissue application number / and was amended on _____ (*if applicable*).

I hereby declare that there is no assignee for this application.

NOTE: "Where no assignee exists, applicant should affirmatively state that fact. If the file record is silent as to the existence of an assignee, it will be presumed that no assignee exists." M.P.E.P., 6th ed., rev. 1, § 1410.01.

B. DECLARATION BY ASSIGNEE

NOTE: The assignee of the entire interest may make the declaration, if the reissue application does not seek to enlarge the scope of the claims of the original patent. 37 C.F.R. § 1.172.

(type or print name of declarant) _____ Title _____
of _____
Name of company or legal entity on whose behalf declarant is authorized to sign _____
declare that I am a citizen of _____ and resident of _____,
_____, that the entire title to letters patent number _____,
for _____
granted on _____, 19____ to _____
Inventor(s) _____
is vested in _____
Name of company or legal entity _____

that I believe said named inventor(s) to be an original, first and sole inventor (*if only one name is listed*) or an original, first and part inventor (*if plural names are listed*) of the subject matter that is described and claimed in the aforesaid letters patent and in the foregoing specification and for which invention I solicit a reissue patent.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR
(37 C.F.R. § 1.175)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information that is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

In compliance with this duty, there is attached an information disclosure statement in accordance with 37 C.F.R. § 1.98.

PRIORITY CLAIM

NOTE: A "claim" for the benefit of an earlier filing date in a foreign country under 35 U.S.C. 119(a)-(d) must be made in a reissue application even though such a claim was made in the application on which the original was granted. However, no additional certified copy of the foreign application is necessary. M.P.E.P., 6th ed., rev. 1, § 1417.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete C or D)

C. No such applications have been filed.
D. Such applications have been filed as follows:

**EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION**

Country	Application No.	Date of filing (day, month, year)	Date of issue (day, month, year)	Priority Claimed
PCT	AU95/00073	15/02/95		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>
AU	PM 3876	15/02/94		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>
AU	PN 0176	21/12/94		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/>

**ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION**

BENEFIT OF PROVISIONAL APPLICATION

**STATEMENT OF INOPERATIVENESS
OR INVALIDITY OF ORIGINAL PATENT**
(37 C.F.R. § 1.175)

That I believe the original patent to be

partly
 wholly

inoperative or invalid by reason of (37 C.F.R. § 1.175(a)(1)):

(check all items that may apply)

a defective specification
 a defective drawing
 the patentee claiming more or less than the patentee had a right to claim in the patent.

NOTE: At least one error must be relied upon as the basis for the reissue. 37 C.F.R. § 1.175(a)(1).

That the error listed above, which are being corrected, up to the time of the filing of this reissue declaration arose without any deceptive intention on the part of the applicant. (37 C.F.R. § 1.175(a)(2)).

NOTE: For any error corrected not covered by this declaration applicant must submit, before allowance, a supplemental declaration stating that every such error arose without any deceptive intention on the part of the applicant. 37 C.F.R. § 1.175(b)(1).

Corroborating affidavits or declarations of others accompany this declaration.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

(check the following item, if applicable)

- I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

DIRECT TELEPHONE CALLS TO: (Name and telephone number)

Address

248-647-6000

Douglas W. Sprinkle
Gifford, Krass, Groh, Sprinkle
Anderson & Citkowski, P.C.
280 N. Old Woodward, Suite 400
Birmingham, MI 48009

Customer Number 25006

(Reissue Application Declaration and Power of Attorney [17-6]—page 4 of 6)

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signature(s)

BY THE INVENTOR(S)

Full name of sole or first inventor Sergi Yudanov

Inventor's signature 

Date  Country of Citizenship Australia

Residence _____

Post Office Address _____

Full name of second joint inventor, if any William Richard Mitchell

Inventor's signature 

Date  Country of Citizenship Australia

Residence _____

Post Office Address _____

BY ASSIGNEE OR PERSON AUTHORIZED TO SIGN ON BEHALF OF ASSIGNEE

NOTE: Even though inventor(s) do not sign, complete above information for inventor(s).

(complete the following, if applicable)

(type name of assignee)

Address of assignee

Title of person authorized to sign on behalf of assignee

Assignment recorded in PTO on _____

Reel _____

Frame _____

A separate "ASSIGNMENT (DOCUMENT) COVER SHEET"

or FORM PTO 1595 is submitted herewith along with the assignment

ment _____

STATEMENT BY ASSIGNEE

Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

INVENT ENGINEERING PTY. LTD.

Signature of assignee or person authorized to
sign on behalf of assignee

(check proper box(es) for any added page(s) forming a part of this declaration)

Signature for third and subsequent joint inventors. Number of pages added. _____

Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added. _____

Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. § 1.47. Number of pages added. _____

Statement of inoperativeness or invalidity of original patent. 37 C.F.R. § 1.175. Number of pages added 1 _____

Authorization of attorney(s) to accept and follow instructions from representative.

Corroborating statements of others.

(Reissue Application Declaration and Power of Attorney [17-6]—page 6 of 6)

STATEMENT BY ASSIGNEE

Attached is a "STATEMENT UNDER 37 C.F.R. 3.73(b)," establishing the right of the assignee to take action in this reissue.

SERGI YUDANOV

Signature of assignee or person authorized to sign on behalf of assignee

(check proper box(es) for any added page(s) forming a part of this declaration)

Signature for third and subsequent joint inventors. Number of pages added. _____

Signature by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added. _____

Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 C.F.R. § 1.47. Number of pages added. _____

Statement of inoperativeness or invalidity of original patent. 37 C.F.R. § 1.175. Number of pages added _____

Authorization of attorney(s) to accept and follow instructions from representative.

Corroborating statements of others.

This page is being filed under 37 C.F.R. § 1.175.

(Reissue Application Declaration and Power of Attorney [17-6]—page 6 of 6)

**REISSUE APPLICATION DECLARATION AND POWER OF ATTORNEY
(BY INVENTOR(S) OR ASSIGNEE)**

ADDED PAGE

As the below named inventor, I hereby declare: my residence, post office address and citizenship are as stated below next to my name; and I believe I am the original, first and sole inventor of the invention which is described and claimed in U.S. Patent 5,785,021 entitled HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM that issued July 28, 1998, and in the reissue application thereof the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I believe that my original patent is partly inoperative or invalid for the reason that I claimed less than I had a right to claim in the patent.

Specifically, the patent was based upon Application No. PCT/AU95/00073. That PCT Application, as originally filed with the U.S. Patent and Trademark Office included 14 claims. However, Claim 14, a method claim, appears to have never been considered by the patent office. Furthermore, on November 12, 1996 a Supplemental Preliminary Amendment was filed that added new Claims 19-21. Those claims were subsequently allowed and renumber Claims 16-18 but were not printed as part of the patent. The amended Claim 14 and unpublished Claims 16-18 have been added to the present application as Claims 16-19.

Claim 3 has been amended to delete the multiple dependencies that should have been originally removed as a result of the Supplemental Preliminary Amendment filed November 12, 1996. Initially, Claims 5 and 11 have been amended to more clearly disclose and claim the invention.

I further declare that the aforementioned error occurred without any deceptive intention on my part and that all statements made herein of my own knowledge are true and that the statements are made with the knowledge that willful false statements and the like so made are punishable by fine, imprisonment or both under Section 1001 under Title 18 of the United States Code and such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Therefore, I pray that I be allowed and I hereby offer to surrender the original United States Letters Patent No. 5,785,021 for HYDRAULICALLY ACTUATED ELECTRONIC FUEL INJECTION SYSTEM and that the Letters Patent may be reissued to claim and protect all that I was entitled to claim.

(Reissue Application Declaration and Power of Attorney [17-6] _____ Added page _____)

Practitioner's Docket No. DCC-10003/04

PATENT

ASSENT BY ASSIGNEE FOR FILING OF REISSUE APPLICATION

NOTE: The written assent of all assignees, if any, owning an undivided interest in the original patent must be included in the application for reissue. 37 C.F.R. 1.172(a).

This is part of the application for a reissue patent filed herewith based on the original patent identified as follows:

Sergi Yudanov and William Richard Mitchell
Name of Patentee

5,785,021
Patent Number

7/28/98
Date Patent Issued

Hydraulically Actuated Electronic Fuel Injection System
Title of Invention

I am an assignee owning

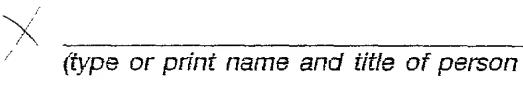
an undivided interest to the above original patent.
 a 50 % (per cent) interest in the above original patent.

I assent to the accompanying application for reissue.

Invent Engineering Pty Ltd
Name of assignee

 Date: _____

Signature of person signing for assignee

 (type or print name and title of person signing for assignee)

Practitioner's Docket No. DCC-10003/04

PATENT

ASSENT BY ASSIGNEE FOR FILING OF REISSUE APPLICATION

NOTE: The written assent of all assignees, if any, owning an undivided interest in the original patent must be included in the application for reissue. 37 C.F.R. 1.172(a).

This is part of the application for a reissue patent filed herewith based on the original patent identified as follows:

Sergi Yudanov and William Richard Mitchell
Name of Patentee

5,785,021
Patent Number

7/28/98
Date Patent Issued

Hydraulically Actuated Electronic Fuel Injection System
Title of Invention

I am an assignee owning

an undivided interest to the above original patent.
 a 50 % (per cent) interest in the above original patent.
I assent to the accompanying application for reissue.

Sergi Yudanov
Name of assignee

X

Signature of person signing for assignee

X

Date: _____

Sergi Yudanov
(type or print name and title of person signing for assignee)